

## REMARKS

The official action of 15 September 2008 has been carefully considered and reconsideration of the application as amended is respectfully requested.

Applicants hereby affirm their election of the invention defined by the claims of Group I, i.e., claims 1-13. Of these claims, claims 12-13 have been rewritten as method of treatment claims to insure compliance with the provisions of 35 USC 112 and 35 USC 101 (see MPEP 2173.05(q)). Should these claims as amended not be considered as drawn to the elected invention, Applicant respectfully requests that they be held in abeyance for possible rejoinder if and when the product claim from which they depend is deemed allowable. The withdrawn method claims have also been rewritten to depend from the elected product claims so as to facilitate their rejoinder upon the allowance of the product claims (see MPEP 821.04).

New claim 23, which is a product-by-process claim drawn to the elected product, has been added more completely to define the subject matter which Applicants regard as their invention. Support for the subject matter in this claim appears in the specification as filed at, for example, page 4, lines 3-10, and page 7, lines 2-5, and Fig. 1 of the drawings.

The claims have also been amended to remove the bases for the claim

objection and the rejection under 35 USC 112, second paragraph appearing at page 5 of the official action. All claims as amended are respectfully believed to be sufficiently definite to satisfy the dictates of 35 USC 112, second paragraph.

The claims stand rejected under 35 USC 102(b) as allegedly being anticipated by Okabe or Sakamoto et al or Robb. The claims also stand rejected under 35 USC 103(a) as allegedly being unpatentable over Okabe in view of Huang et al or Watson et al or Blake et al. Applicants respectfully traverse these rejections.

The claimed invention is based at least in part upon Applicants' discovery that the modification of the surface of titanium dioxide particles by chemically bonding a hydrophilic polymer onto the surface of the titanium dioxide fine particles can greatly improve the dispersibility in an aqueous solvent of the particles over a broad pH range. This is described in the specification at, for example, page 3, line 25 to page 4, line 29 and is exemplified in the Examples beginning on page 11. The Examples show, among other things, that when a hydrophilic polymer is chemically bonded to the surface of the titanium dioxide particles through an ester linkage, the resultant surface modified particles have improved dispersibility in an aqueous solvent as compared with a case in which the hydrophilic polymer is merely mixed with the titanium dioxide particles without chemical bonding. See Example 16 on page 21 of the specification. The chemical bonding of a hydrophilic polymer to the surface of titanium dioxide particles is shown diagrammatically in Fig. 1 of the drawings.

As next discussed, none of the cited references shows or suggests the surface modified titanium dioxide fine particles as claimed.

*Claim Rejections-35 USC § 102*

Okabe

Okabe describes reacting an oxypolycarboxylic acid with a polyol compound and a complex alkoxide having a chemical bond of (-Ti-O-Al-O-Ti-) to provide a water-soluble composite carboxylic ester complex oligomer. A solution of the composite carboxylic ester complex oligomer is then sprayed and thermally degraded to produce a TiO<sub>2</sub> powder.

As described in Okabe at, for example, paragraphs [0005] and [0006], the final product obtained by the Okabe process is TiO<sub>2</sub> powder having crystals in which aluminum is substituted into titanium positions. As described in Okabe at, for example, paragraph [0005], the TiO<sub>2</sub> powder is not formed until the spray pyrolysis step ("...the solution of of the composite carboxylic acid ester complex oligomer is subjected to spray pyrolysis within an atmosphere with a temperature of 500°C - 850°C in order to obtain a TiO<sub>2</sub> powder for use in photochemical reactions").

As may be appreciated from the above, the solution before the spraying and thermal degrading is a solution of an organic metal compound **complex** intermediate, not a  $\text{TiO}_2$  powder as claimed. Thus, although the Examiner refers at paragraph 12 of the official action to the reference as describing a  $\text{TiO}_2$  granular material comprising ester linkages, this is respectfully in error. The intermediate **complex** does not comprise  $\text{TiO}_2$  and is not granular. On the other hand, the  $\text{TiO}_2$  powder after the spraying and the thermal degrading is nothing but an inorganic compound on/in which carboxylic acid or ester no longer exists.

Accordingly, Okabe fails to disclose or suggest surface modified titanium dioxide fine particles as defined in any of the claims. (Note: with particular respect to product-by process claim 23, the structure implied by the process steps should be considered when assessing the patentability of product-by-process claims over the prior art, especially where, as here, the manufacturing process steps would be expected to impart distinctive structural characteristics to the final product. See MPEP 2113.).

*Sakamoto et al*

Sakamoto et al discloses a neutral aqueous dispersion containing hydrous titanium oxide particles having a maximum particle size of less than  $1.0\ \mu\text{m}$  and at least one dispersion-stabilizer (claim 1). Preferable examples of the dispersion-stabilizer include carboxymethyl cellulose (col. 2, line 51). The mixture of the  $\text{TiO}_2$  dispersion and the dispersion-stabilizer is concentrated by

heating (col. 3, lines 63-64).

However, the dispersion medium in the dispersion to be concentrated in the Sakamoto reference is water, which is protic solvent. In this regard, the description on page 8, lines 10-22 and Example 12 of the specification indicates that protic solvent inhibits binding reaction of the hydrophilic polymer (such as polyacrylic acid) onto the surface of the titanium oxide particles. Thus, it is impossible to produce surface modified titanium dioxide fine particles of the present invention in accordance with the method of the Sakamoto reference using water as a dispersion medium. Accordingly, Sakamoto et al fails to disclose or suggest surface modified titanium dioxide fine particles of the present invention.

#### *Robb*

Robb discloses an aqueous dispersion of titanium oxide comprising water, particles of titanium dioxide having an acicular shape and a dispersing agent such as polyacrylic acid (col. 4, line 15). Example 3 discloses a dispersion of 50 g of the dried coated TiO<sub>2</sub> product added with 70 ml of water and 5.03 g of the sodium polyacrylate, while Example 21 discloses the composition comprising this dispersion is heated at 70°C.

However, the dried coated TiO<sub>2</sub> product used in Example 3 is particles coated with silica and alumina (col. 7, lines 42-48), which makes it impossible to form an ester between carboxylic acid and OH group on the surface of the

titanium particles. Accordingly, Robb fails to disclose or suggest surface modified titanium dioxide fine particles of the present invention.

The Examiner speculates at paragraph 14 of the official action that "some ester formation would have been expected" in the mixtures described in the reference. However, such speculation is respectfully inadequate to support a rejection based on alleged anticipation wherein a cited reference or references must show that all claim limitations are **necessarily** present in the thing described in the reference. See MPEP 2131.01(III). This is respectfully not possible in the present case for the reasons described above.

In view of the above, the cited references do not show all of the limitations of the claims of record such that they cannot be said to anticipate the claimed invention under the provisions of 35 USC 102.

*Claim Rejections – 35 USC § 103*

*Okabe in view of Huang et al, Watson et al and Blake et al*

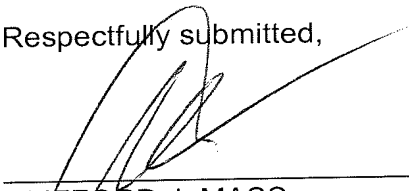
Hung et al, Watson et al, and Blake et al as well as Okabe fail to disclose or suggest surface modified titanium dioxide fine particles in which the carboxyl groups in the hydrophilic polymer is bonded to titanium dioxide through an ester linkage. Accordingly, the combination of the Okabe reference with the Huang reference, the Watson reference or the Blake reference would never lead to surface modified titanium dioxide fine particles of the claimed invention.

In short, surface modified titanium dioxide fine particles according to the claimed invention have on the surface thereof a hydrophilic polymer through an ester linkage and, thus, have very good dispersibility in aqueous solvents even in a broad range of pH including near-neutral pH. Further, a dispersion liquid of surface modified titanium dioxide particles utilizing this feature can utilize water- or salt-containing various pH buffer solutions as solvents and has very good dispersibility and stability. No such benefits and surface modification attaining the benefits are found in any of the cited references. Thus, Applicants respectfully submit that the references cannot set forth even a *prima facie* case of anticipation or obviousness for the invention as claimed such that the rejections of record should be withdrawn.

Claims 1-8 and 10-11 were provisionally rejected on the ground of nonstatutory obviousness-type double patenting as allegedly being unpatentable over claims 1-7 and 13-15 of copending Application No. 10/551164. Applicants respectfully elect to defer a response to this provisional rejection unless and until it is converted into an actual double patenting rejection. See MPEP 804.

In view of the above, Applicants respectfully submit that all rejections and objections of record have been overcome and that the application is now in allowable form. An early notice of allowance is earnestly solicited and is believed to be fully warranted.

Respectfully submitted,



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